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Effects-Based Operations using the Strategy Development Tool

73rd MORSS WG14: Strike Warfare

June 21-23, 2005



Dr. Christopher M. White



Nicholas J. Pioch

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- 
- **Background**
 - **SDT Overview**
 - **JEFX04 Lessons Learned**
 - **Conclusions**

- **Developing an effect-based strategy development tool (SDT)**
 - Focus is on planning air campaign operations
 - Compatible with evolving effect-based operations concepts
- **Sponsored by AFRL Effects Based Operations (EBO) Advanced Technology Demonstration (ATD)**
- **Research started in 2001**
- **Research culminated with JEFX04 EBO tools initiative**
- **Technology transition includes design inputs for**
 - Strategy Planning Tool (SPT) in TBMCS 1.1.3
 - Information Warfare Planning Capability (IWPC) 4.2



- **Mixed-initiative approach using adversary models to guide effects-based plan refinement**
 - Start with strategic-theater-level mission
 - Analyze and model the enemy system of systems
 - Decompose mission into strategic and operational-level effects and tasks
 - Decompose further into tactical-level tasks and target sets
 - Provide indicators and collection requirements for feedback during plan execution
- **Provide tools to analyze**
 - The impact of interventions on the probability of enemy goals, beliefs or actions
 - Target system models to compare predicted outage profiles and workarounds
 - Cross-model network flow models in order to suggest tactical tasks and target sets



- **Collaborative Joint Campaign Mission Analysis**
- **Target System Analysis**
- **Effects Based Modeling and Analysis**
- **Network-centric Effects Based Planning**
- **Effects Based COA Decision Support Tools**
- **Target Option Analysis**
- **Dynamic Coarse of Action Decision Tool**

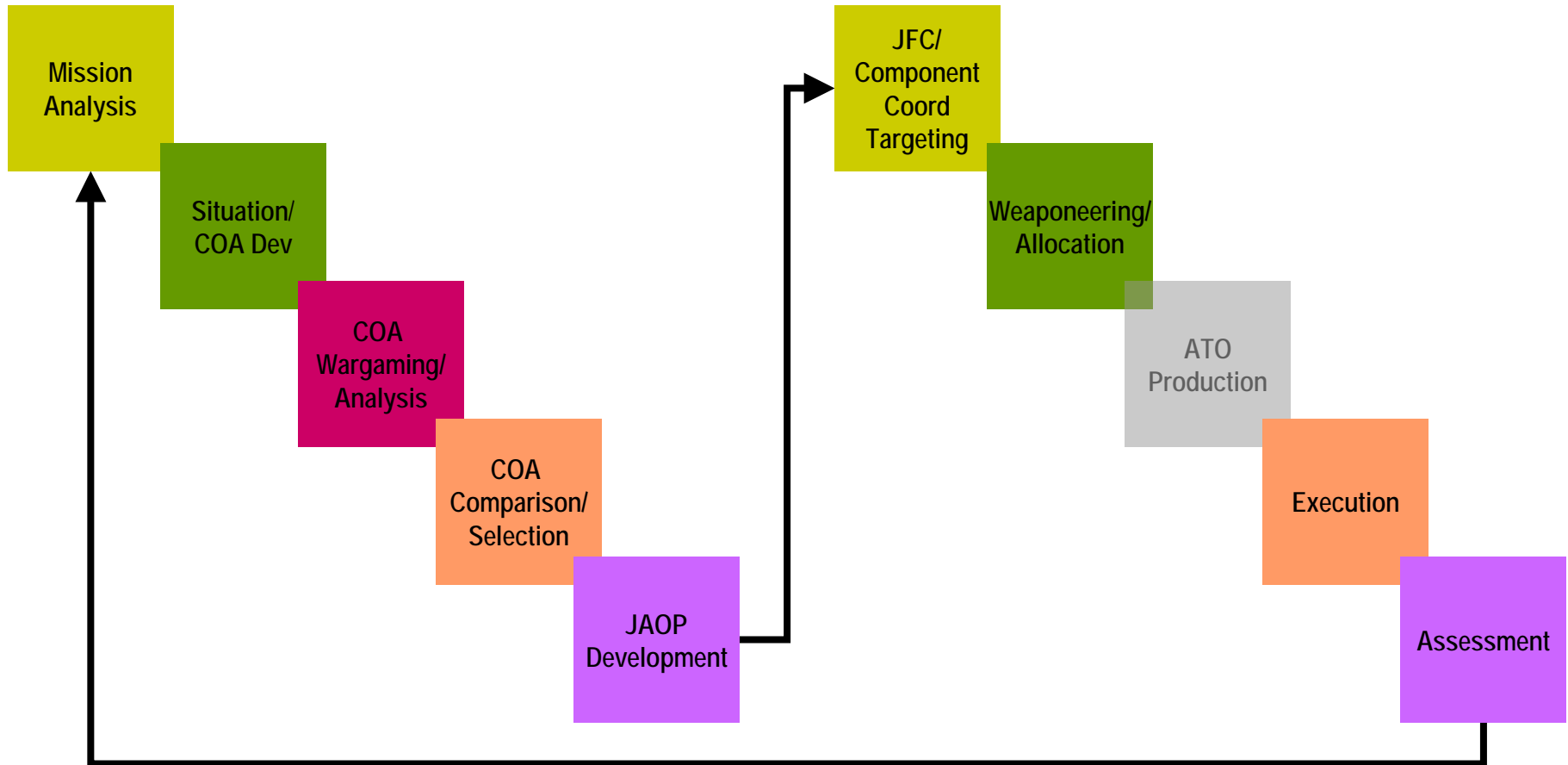


Applying Effects-Based Operations to JP 3-30 Command and Control for Joint Air Operations

BAE SYSTEMS

Joint Air Estimate Process

Joint Air Tasking Order Process



Collaborative Mission Analysis

BAE SYSTEMS

Mission Analysis

Commander's Intent

Central Repository for
One Time Entry

Mission Analysis for JFC

Specified Tasks | Implied Tasks | Resources | Limitations | CCIR | Facts

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Specified

- Develop a Flexible Deterrent Option (FDO) that concern' to Califon. Note this FDO is not part o and assessed by CINCMED Joint Force Head
- Develop strike COA options, with supporting
a)(U) Strike with lethal means only
b)(U) Strike with non-lethal means only
c)(U) Strike with a mix of lethal and non-lethal n
- Wargame each option with attention to attrition
- Provide Branch plans for each COA option that
a)(U) TCT: upgraded (e.g., 3rd generation) Cali
missiles, SU-37 Flanker aircraft), or any TBM/C
b)(U) CSAR

☐ Essential Task

☐ Essential Task

☐ Essential Task

☒ Essential Task

Add Del

OK Cancel

Commander's Intent for JFC

Purpose | Method | Endstate | Risk

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Endstate

- USMED COM will be successful if Califon's WMD is disrupted to a point where Califon determines negotiation is preferable to losing their WMD assets completely.
- The end state will be reached when Califon's WMD no longer poses a threat to regional states or could threaten US deployments into the region.

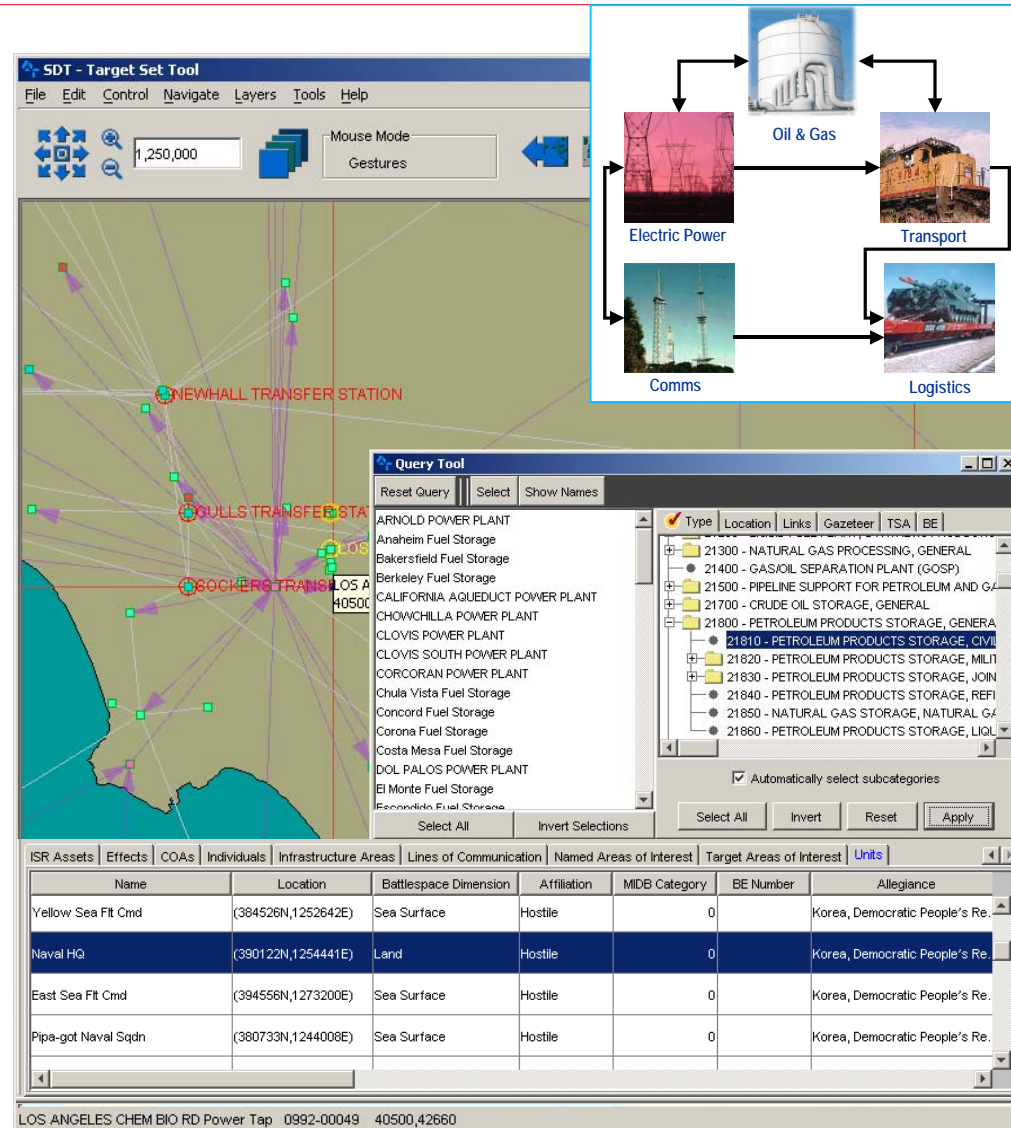
Add Delete

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Real-Time Collaborative
Updates by Multiple Users

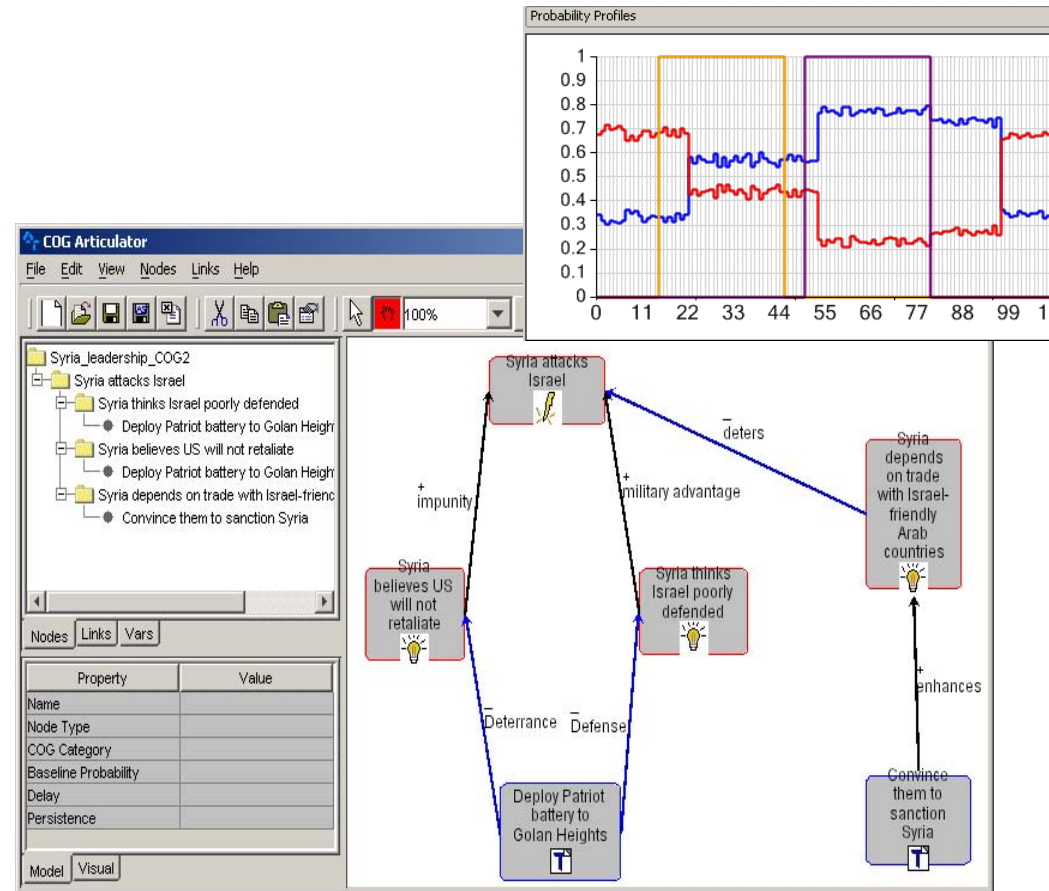
Target System Analysis

- Visualize IPB data, target system nodes & links
- Query based on target category, location, name, or links
- Specify target lists for strike, no-strike, affect, do-not-affect



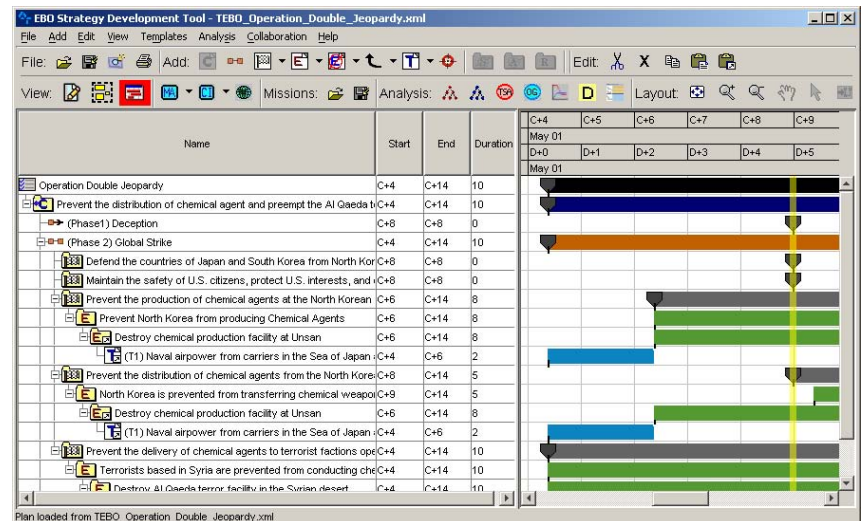
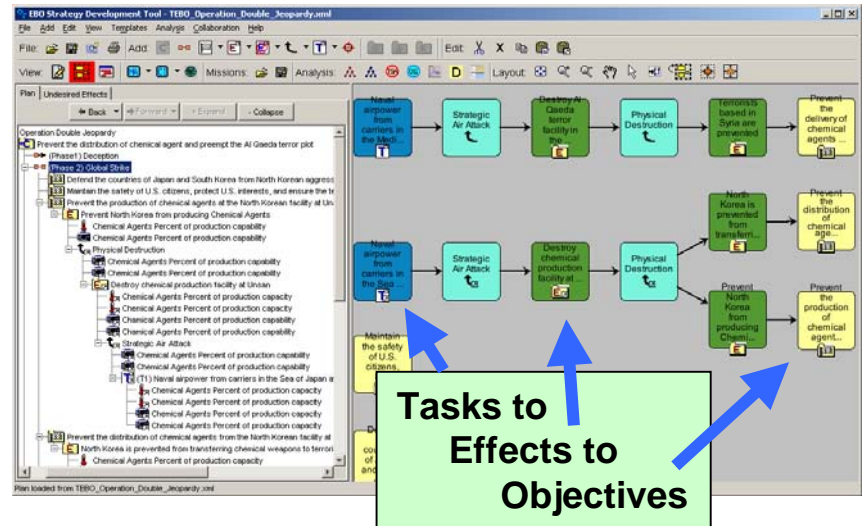
Effects Based Modeling and Analysis

- Captures planners/analysts concept of the enemy system
 - **Red actions, goals, beliefs, resources**
 - **Positive, negative causal linkages**
- Analyzes probability of effects over time for different blue actions
- Explains blue strategy, based on impact to enemy COGs
- Exports causal chains to plan
- Supports Operational Assessment of evidence on indicators

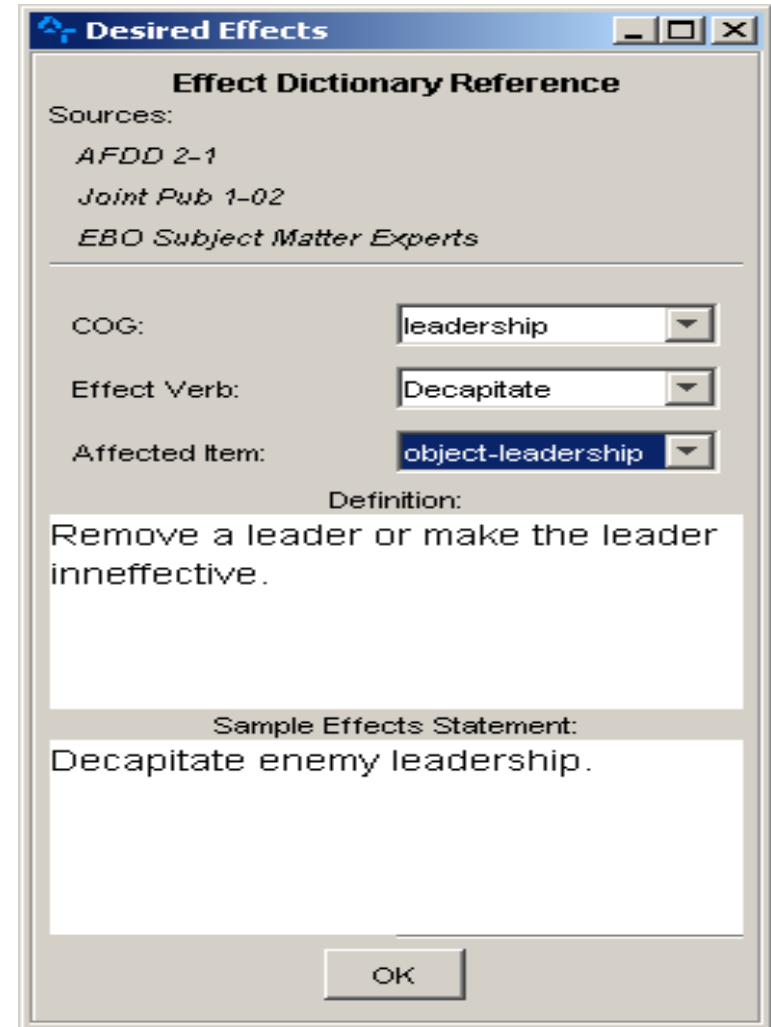


Network-centric Effects Based Planning

- COA development for deliberate and crisis action planning
- Multiple views into a common plan supports plan development and analysis
- Real-time collaboration facilitates communication between decision-maker and planners
- Plan templates created during deliberative planning can be used for crisis action planning
- Integrated with adversary modeling and analysis tools
- Uses simplified causal modeling semantics
 - Causal strength
 - Scheduled probabilities
 - Delay, persistence



- Dictionary of effect verbs with definitions and sample effect statements
- Includes definition sources
- Useful for forming common consensus on planning terminology



The screenshot shows a software window titled "Desired Effects". Inside, there is a section titled "Effect Dictionary Reference". Under "Sources:", it lists "AFDD 2-1", "Joint Pub 1-02", and "EBO Subject Matter Experts". Below this, there are three dropdown menus: "COG:" with "leadership" selected, "Effect Verb:" with "Decapitate" selected, and "Affected Item:" with "object-leadership" selected. Under "Definition:", it says "Remove a leader or make the leader ineffective.". Under "Sample Effects Statement:", it says "Decapitate enemy leadership.". At the bottom right is an "OK" button.



Planning for Assessment

- **Measures of Effectiveness**

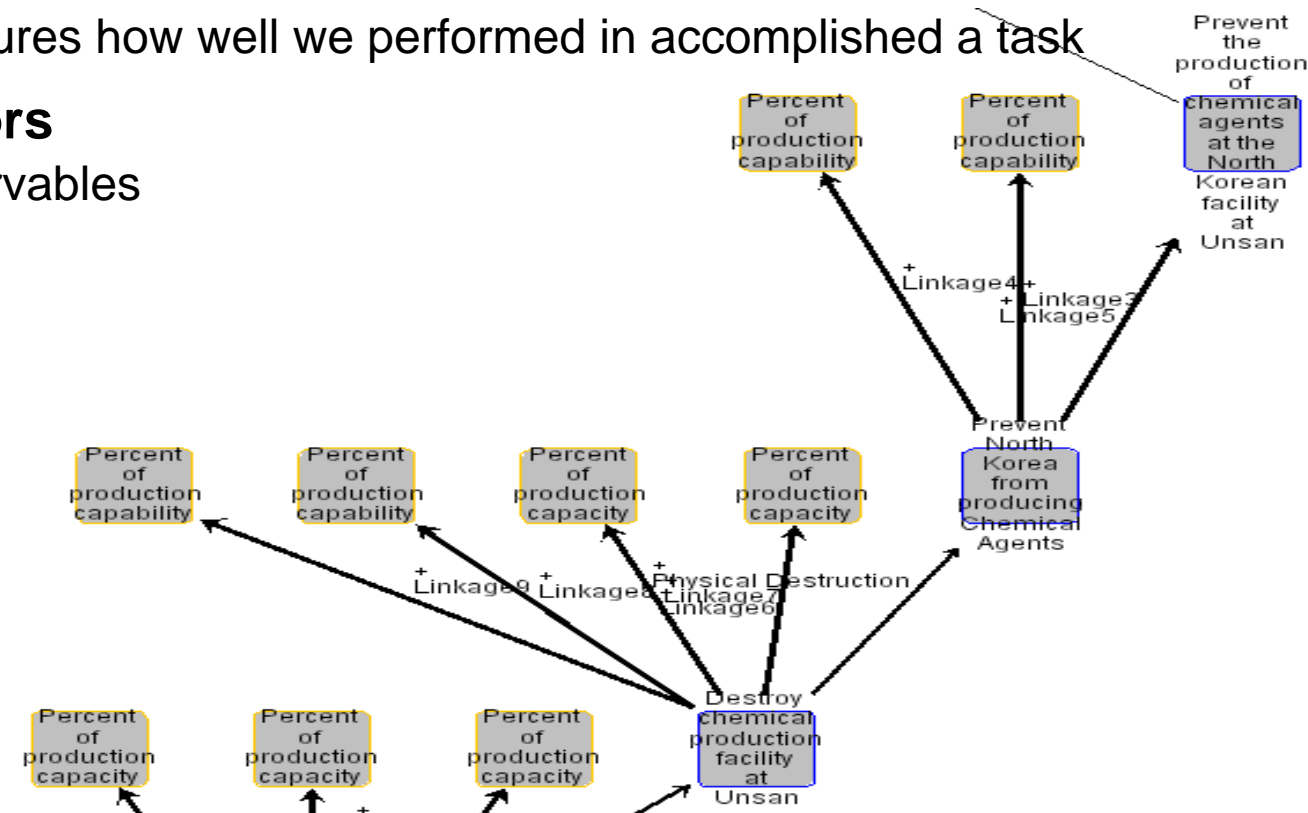
- Defined for each Objective and Effect
- Measures how well we are accomplishing desired effects

- **Measures of Performance**

- Defined for each Task
- Measures how well we performed in accomplished a task

- **Indicators**

- Observables

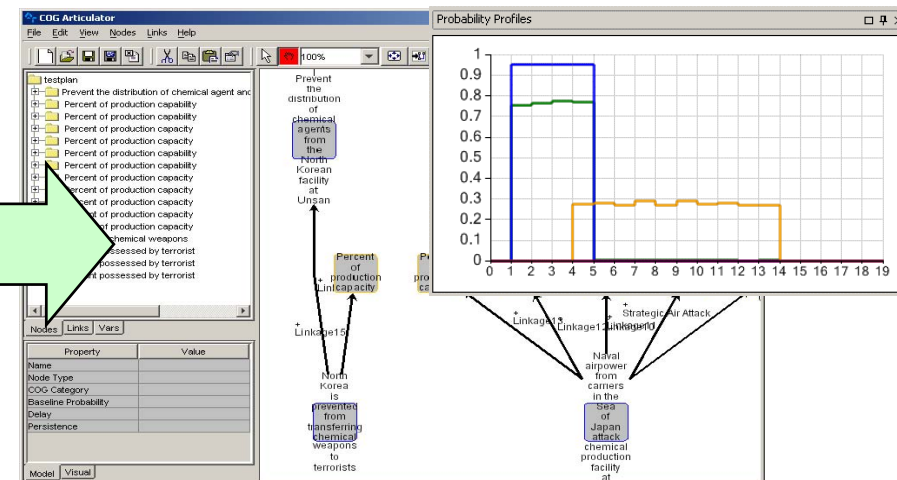
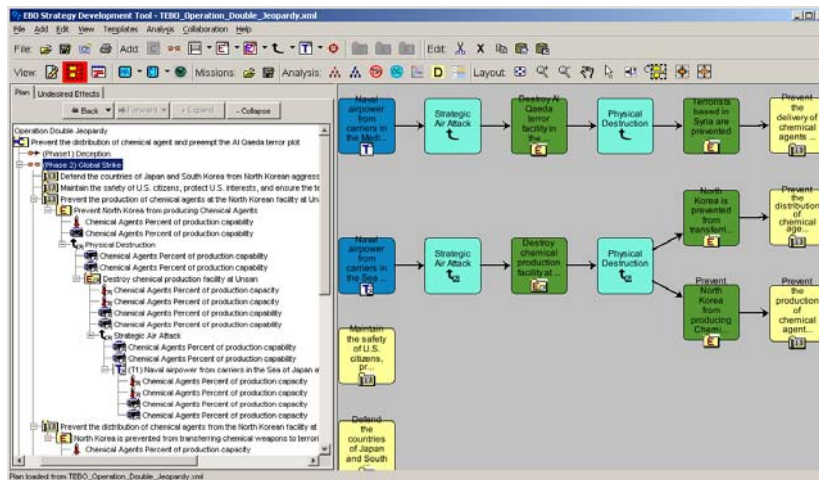


Effects Based COA Decision Support Tools

- COA Comparison Matrix supports decision making process
- Integrated COA analysis tool
 - Analyzes Probability/Timing of actions and effects
- Operational Assessment of plan progress

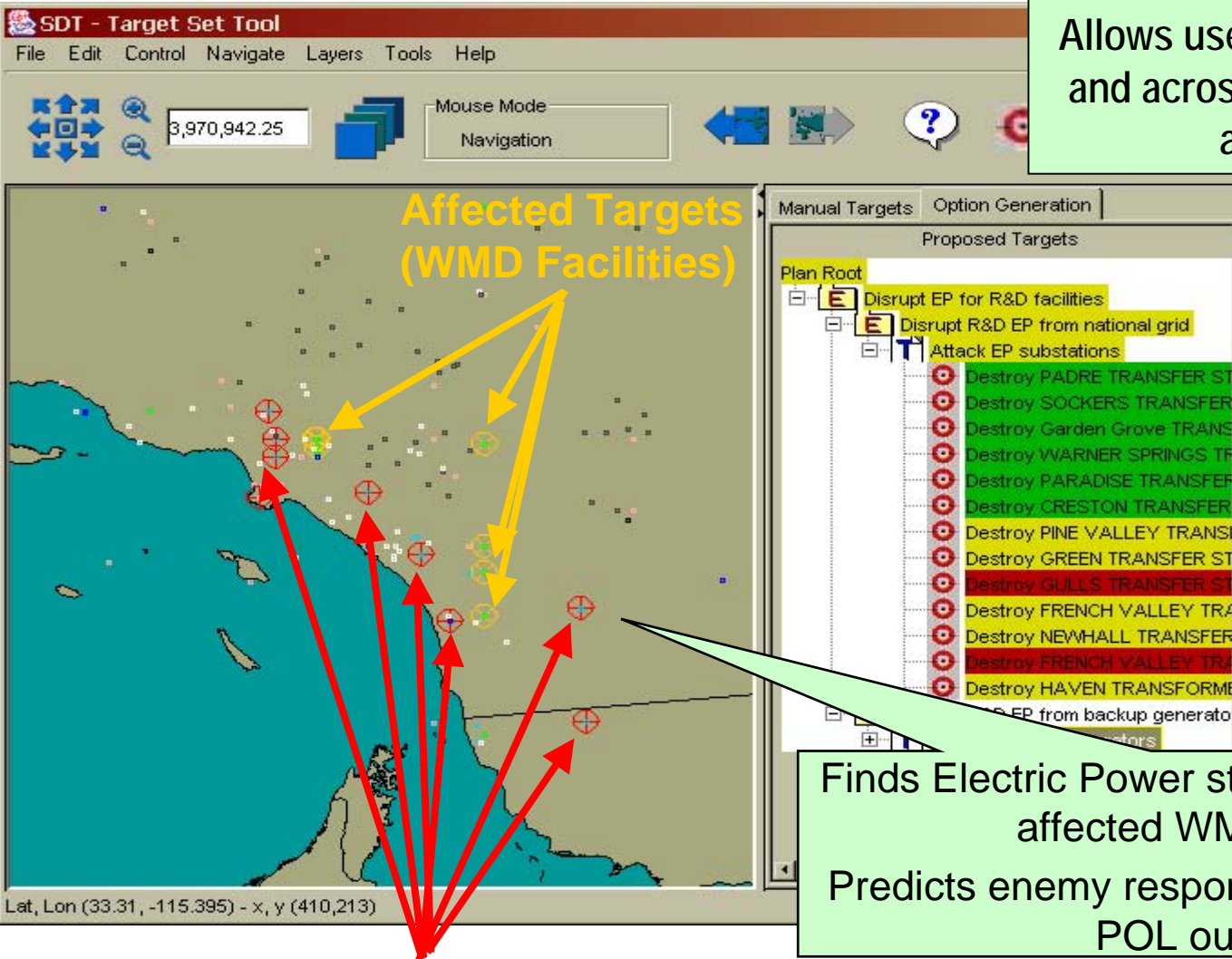
COA Comparison Matrix

Phases	weight	Direct Means	Indirect means
Phase 1	1	50	30
Phase 2	1	40	29
Phase 3	1	50	38
-suitable	2	1	2
-feasible	2	8	8
-acceptable	1	5	5
-complete	1	3	4
-probability of success	3	8	3
Phase 4	1	43	43
Phase 5	1	41	32
Totals	1	224	172
-suitable	2	16	14
-feasible	2	34	26
-acceptable	1	28	29
-complete	1	18	27
-probability of success	3	26	12

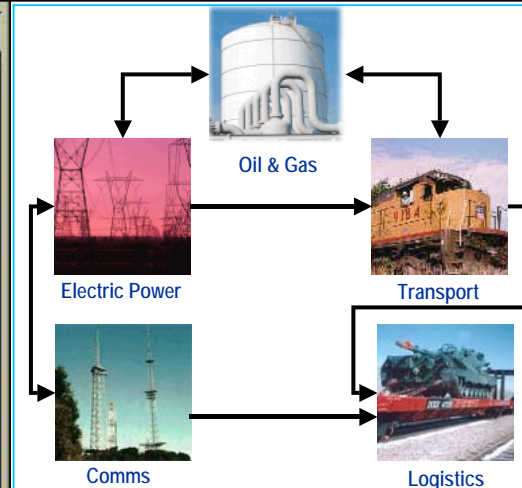


Target Option Analysis

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Allows user to study the enemy within and across systems to identify direct and indirect effects



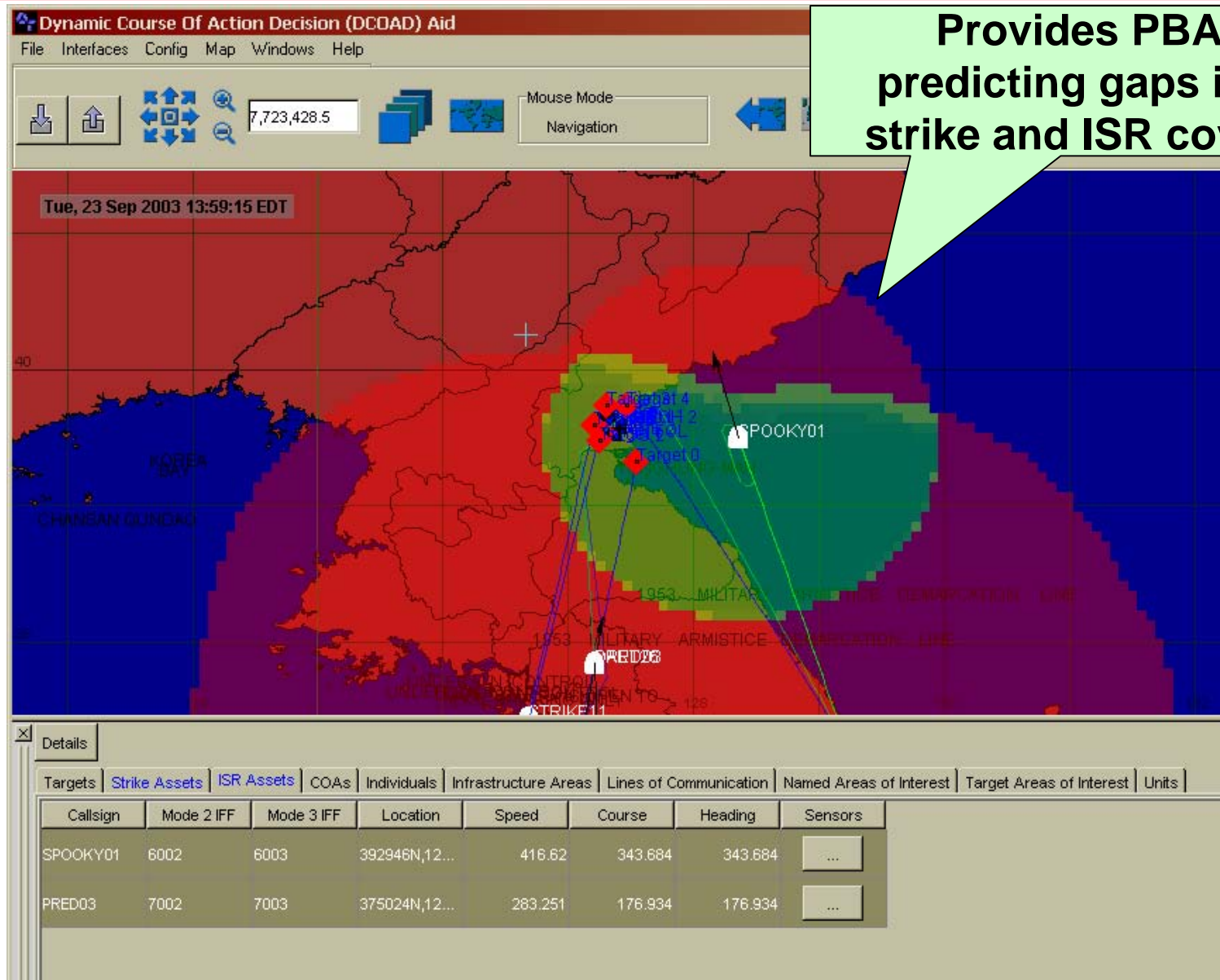
Finds Electric Power strike targets to disrupt affected WMD targets.

Predicts enemy response to electric power, POL outages.



Dynamic COA Decision Aid

BAE SYSTEMS



- 
- Background
 - SDT Overview
 - JEFX04 Lessons Learned
 - Conclusions

- **Biannual joint experiment to**
 - Evaluate new tools and processes
 - Drive improvements to TTP, doctrine
 - Primarily focused on Air Operations Center
- **Distributed Operations**
 - Nellis AFB (AF)
 - Hurlburt AFB (Ground)
- **3 Focus Areas in JEFX '04**
 - Effects-based Operations
 - Predictive Battlespace Awareness
 - Network-Centric Infrastructure
- **Our EBO tools played in AFRL's EBO-PBA initiative**
 - Significant changes between Spiral 2, Spiral 3, Main Ex
 - Joint Air-Ground Branch Planning occurred during Main Ex
 - Ground component introduced to EBO tools during Main Ex

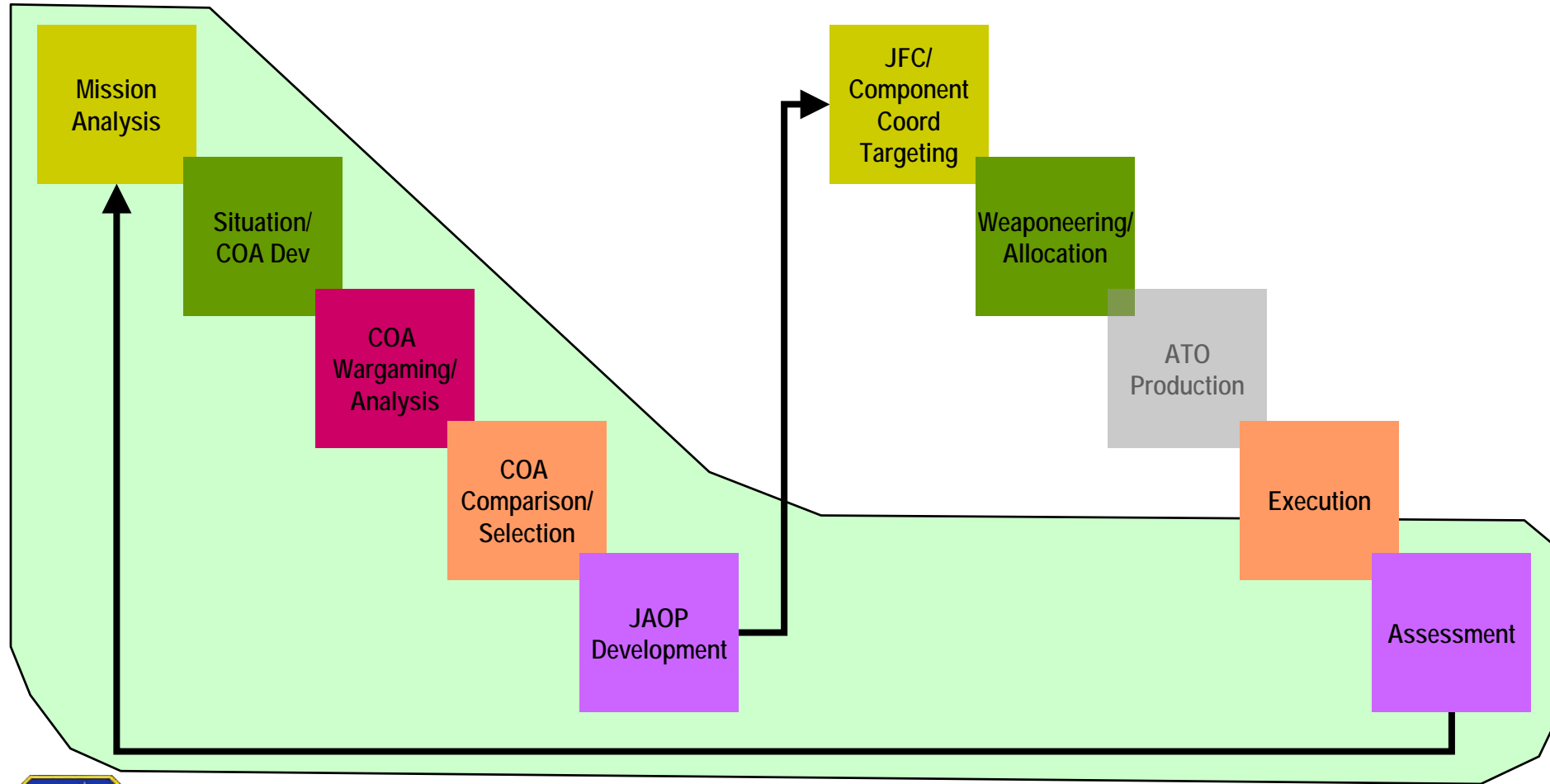


Applying Effects-Based Operations to JP 3-30 Command and Control for Joint Air Operations

BAE SYSTEMS

Joint Air Estimate Process

Joint Air Tasking Order Process



- **JFC developed objectives, effects, and guidance**
- **Assigned effects to components (i.e., JFACC, JFLCC)**
- **Each component developed plan for achieving effects**
- **Components planned in parallel coordinating at multiple points**
- **General Observations**
 - Basic design and concept of employment well-received
 - Need to be cognizant of bandwidth limitations
 - Need more feedback on what has been changed by other users



- **JEFX04 demonstrated a prototype real-time synchronized collaboration capability**
- **An enhanced system would need to provide better support for bandwidth limitations and a larger number of simultaneous collaboration systems**
- **Need added support for Army planning needs such as**
 - Developing a COA Sketch
 - Developing a synch matrix
 - Providing a list of target nominations
 - Assigning resources to tasks
 - Specifying the Method for accomplishing a task
 - Performing mission analysis
 - Multi-echelon planning



- **Dep. Ops Assessment Chief**

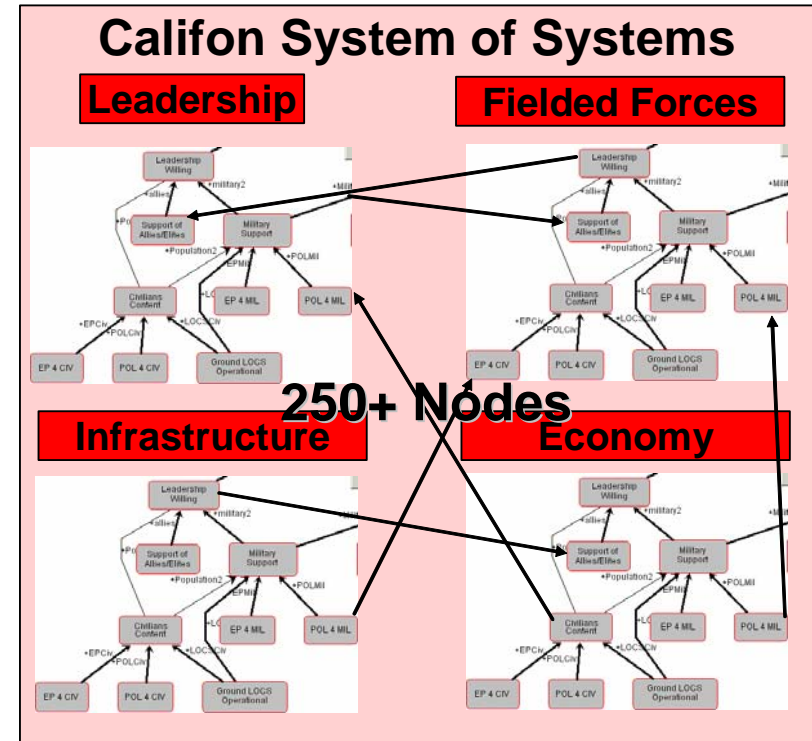
- Built and analyzed complex models (250 nodes, 300 links)
- Iterative process using OAT to analyze incremental model changes

- **Findings**

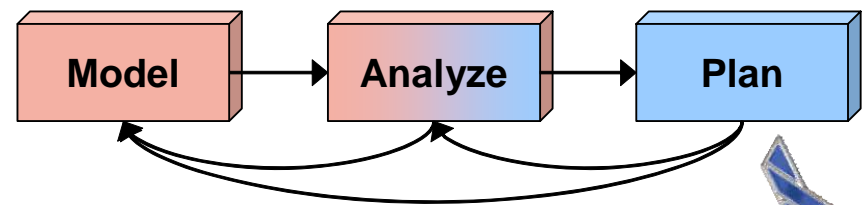
- Need unified tool for both model authoring and analysis
- Need hierarchical navigation, visualization for large models

- **Observations**

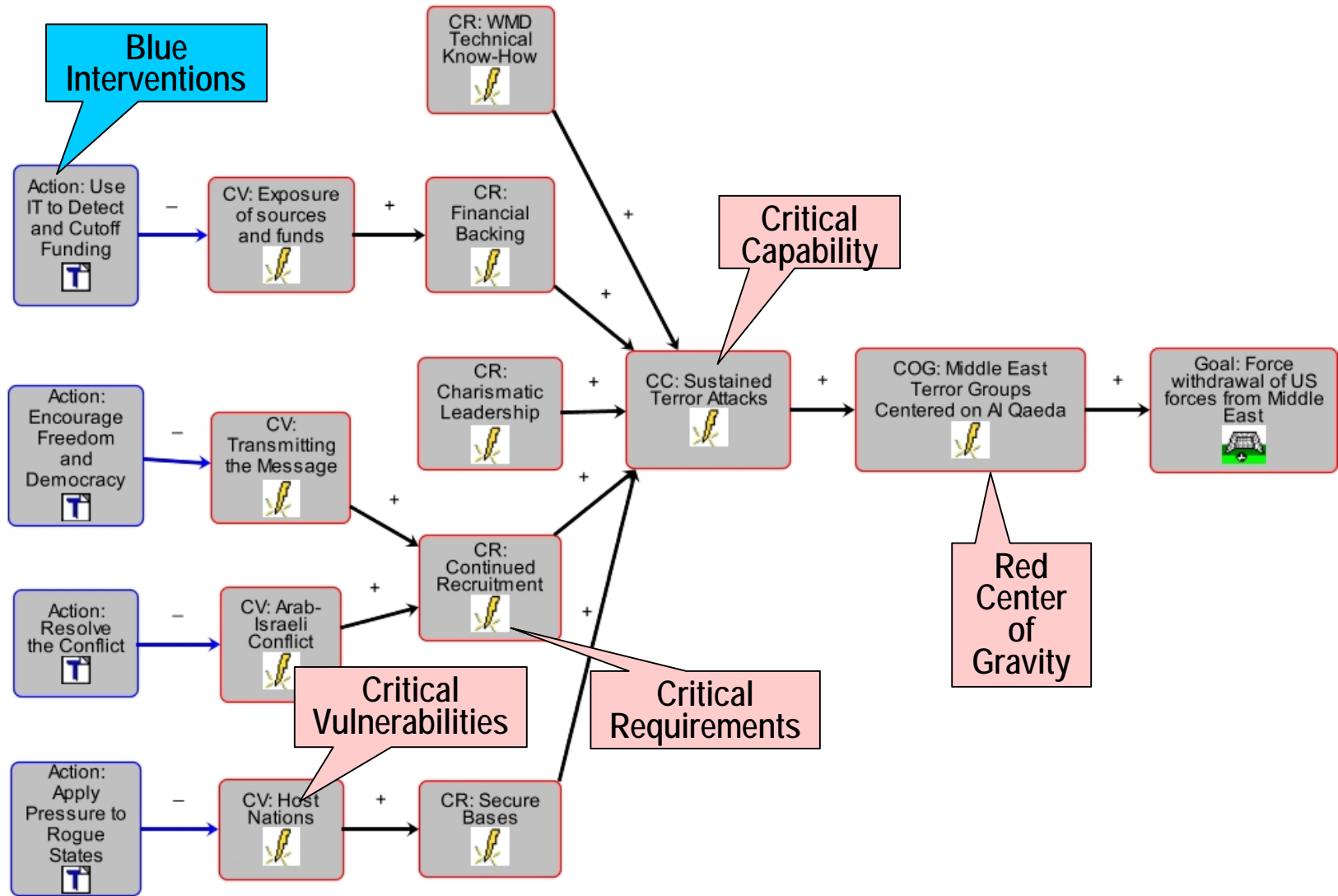
- Other users skeptical of model validity, additional workload
- Models did not inform planning, but were used to validate the plan



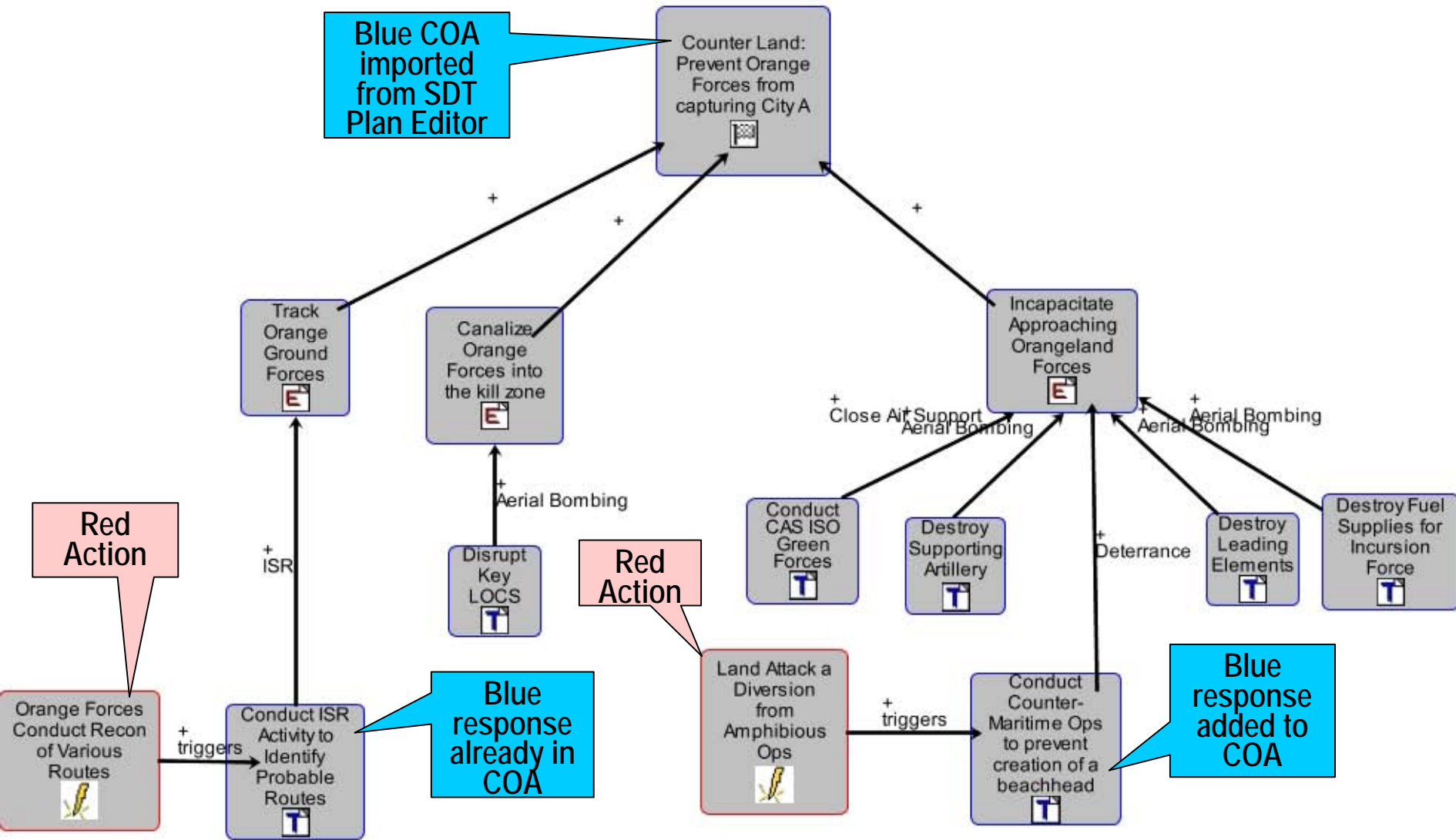
Iterative Modeling Process:



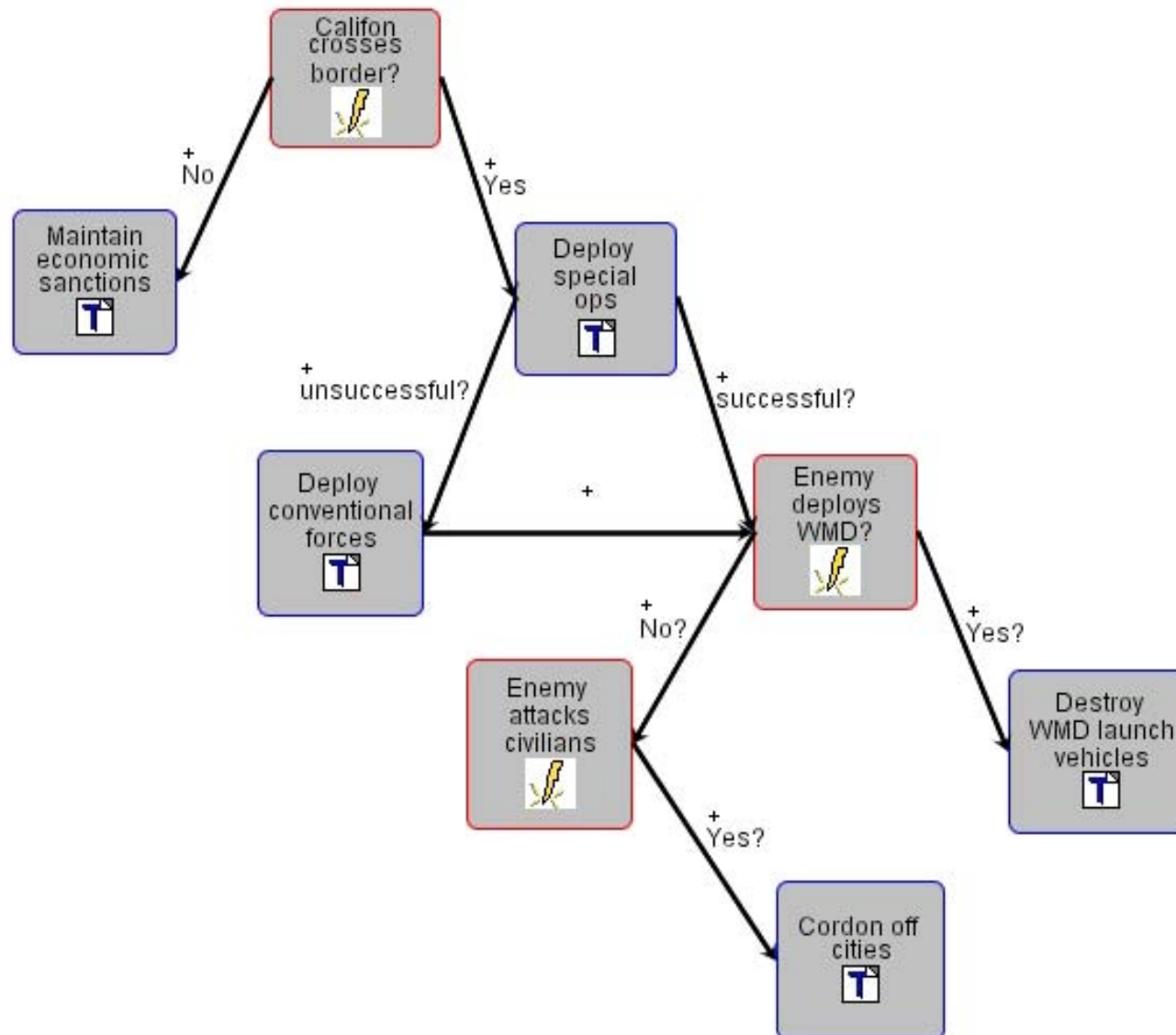
Novel Uses: Strange COG Models



Novel Uses: Blue-on-Red Wargaming



Novel Uses: Decision Tree Wargaming



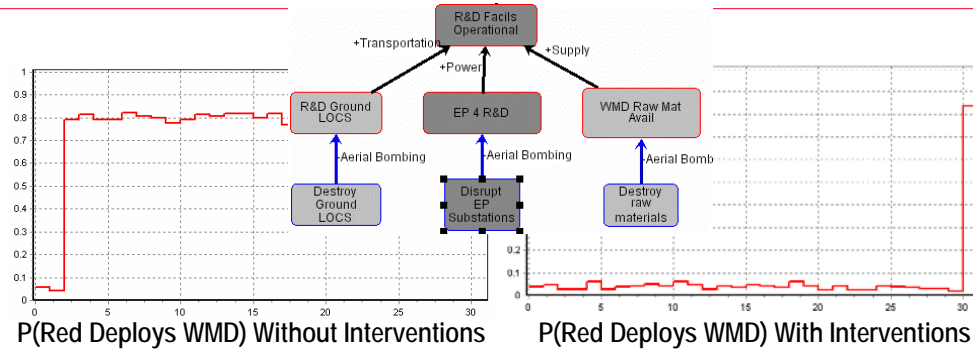
- Appeals to power-users with modeling experience
- Majority of AOC Strategy Team users uncomfortable with added complexity
- Some came to appreciate the value of causal models for effects-based planning
- Need further research in:
 - Qualitative modeling and analysis
 - Visualization techniques for predictive EBO



Model Analysis Findings: 3 Use Cases

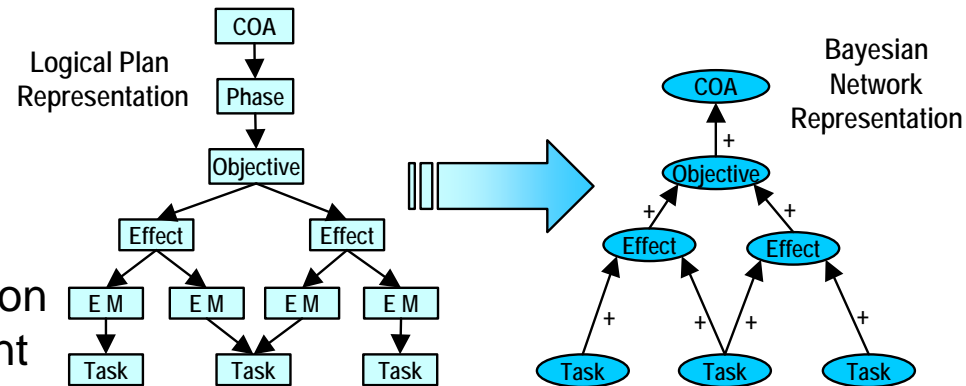
1. Spiral 2 & 3: Predict impact of blue interventions on red model

- Used extensively by Dep OAT Chief
- Intel inputs from ISR Division



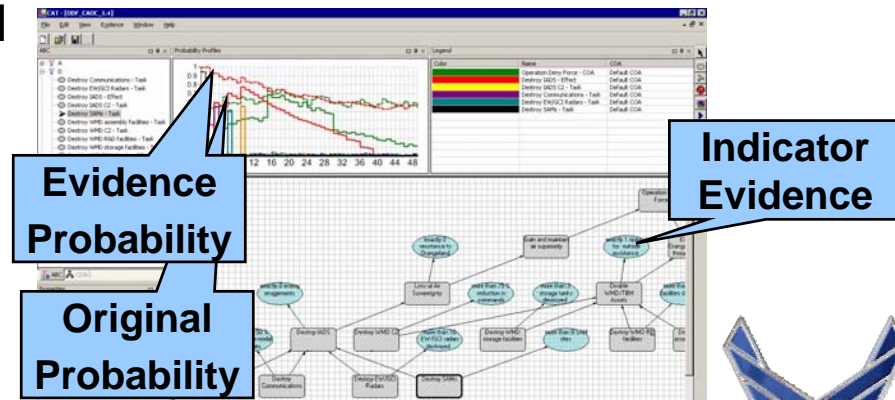
2. Main Ex: Predict blue COA prob. profiles w/out red model

- Used to compare probability and timing of two alternate COAs
- Reinforced JFACC's COA1 selection based on earlier effect achievement



3. Main Ex: Revise probabilities based on indicator evidence

- Delegated to junior lieutenant not familiar with model
- Change in probabilities difficult to explain due to red model complexity



● User Interface Observations

- IWPC more mature, polished, but lacked EBO support
- SDT seen as having most built-in support for EBO
- Users desire one unified strategy tool for EBO rather than several
- Preferred Timeline views with draggable bars
- Desired having Tree/Properties layout
- Identified need for SDT-style Mission Analysis screens
- Users liked the idea of an online dictionary of shared terminology

● Interoperability Observations

- TBMCS Strategy Management Service (SMS) used to exchange data among multiple strategy and targeting tool
- SMS “common” plan schema not true union of strategy producer tools leading to data loss on round trips
- SMS limited to read/write of entire plan
 - Too coarse-grained for true collaboration
 - Needs extensions for updating plan fragments, meta-data for browsing plans, update history



- **SDT provides EBO support for the JAEP**
- **Real-time transparent synchronous collaboration is essential to planning**
- **Adversary Modeling**
 - Needs better integration with ISR Division
 - More automated creation of models
- **JEFX 04**
 - Early feedback drove EBO tools to fit operational needs
 - Tool flexibility allowed experimentation in novel ways
 - EBO methodology needs to be better trained, indoctrinated to gain broader acceptance
- **EBO ATD lessons learned can be valuable for future EBO related efforts including Strike Warfare planning**

